EXPLORING PURPLE YAM STARCH AS TABLET BINDING AGENT, COMPARATIVE STARCH EXTRACTION BY ULTRASOUND AND CONVENTIONAL METHODS

SYNOPSIS

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1. ABSTRACT

BACKGROUND: In pharmaceutical tablet formulation, excipients are essential for dosage stability and effectiveness, with binders like polyvinylpyrrolidone commonly used. There is growing interest in natural alternatives, such as starch from purple yam (*Dioscorea alata*), which offers strong binding properties and health benefits. The extraction method significantly affects the quality and yield of starch, with ultrasound extraction identified as more efficient than traditional methods. Evaluating these techniques is crucial for optimizing high-quality purple yam starch and enhancing sustainability and efficiency in pharmaceutical formulations.

OBJECTIVES: This study evaluates purple yam (*Dioscorea alata*) starch as a natural tablet binding agent by collecting and preparing yam tubers, extracting starch through conventional and ultrasound-assisted methods, and comparing their yields. It analyses the starch's physicochemical properties, formulates tablets, and assesses attributes such as hardness and disintegration time, to determine the feasibility of using purple yam starch as a pharmaceutical excipient in tablet formulations.

METHODS: The document details the process for collecting and preparing purple yam (*Dioscorea alata*) tubers and extracting starch through conventional and ultrasound methods. Fresh tubers are cleaned, peeled, and ground into a slurry, which is filtered in conventional extraction to remove fibrous material, allowing starch sedimentation. The ultrasound-assisted method employs ultrasonic waves to enhance starch release before filtration, drying, and storage. The starch yield and its physicochemical properties, such as moisture content and particle size, are assessed for pharmaceutical suitability. The extracted starch is utilized as a binding agent in tablet preparation, including quality control tests. A comparative analysis of both extraction methods seeks to determine the most effective approach for pharmaceutical use.

RESULTS: Ultrasound extraction of starch from purple yam (*Dioscorea alata*) outperformed conventional methods, yielding improved cell wall breakdown and enhanced starch characteristics, including greater swelling capacity and uniform particle size. Tablets formulated with this starch as a binder exhibited strong mechanical strength, with ultrasound-extracted starch demonstrating higher hardness and lower friability, indicating its efficiency as a high-quality natural pharmaceutical excipient.

CONCLUSION: The study showed that purple yam (*Dioscorea alata*) starch is an effective natural tablet binding agent in pharmaceuticals. It compared conventional extraction to ultrasound extraction, finding that the latter yields more starch and enhances physicochemical properties by improving granule release, thereby increasing efficiency and reducing processing time.

2. INTRODUCTION

Purple yam (*Dioscorea alata*) is an underutilized tuber rich in starch, attracting increasing interest as a natural and sustainable pharmaceutical excipient. Starch is widely used as a tablet binding agent due to its biocompatibility, low toxicity, and cost-effectiveness; however, its functional performance depends greatly on the extraction method. Conventional starch extraction techniques are simple but often time-consuming and may yield starch with variable physiochemical properties.

Recently, Ultrasound extraction has emerged as an alternative technique that enhances starch recovery by improving cell wall disruption through acoustic cavitation. This method can modify starch granule characteristics, potentially improving binding efficiency and tablet performance. Exploring purple yam starch extracted by ultrasound in comparison with conventional methods is therefore important to determine its suitability as a tablet binder. This study aims to comparatively evaluate the binding performance, dissolution behaviour, and stability of tablets formulated with purple yam starch obtained from both extraction methods, highlighting its potential application in pharmaceutical tablet formulations.

3. AIM:

To extract and compare the properties of starch from Purple Yam using Conventional and Ultrasound Extraction techniques, and to evaluate its effectiveness as a tablet binding and disintegrating agent in the formulation of Metformin hydrochloride tablets.

OBJECTIVE:

Extraction of Starch from Purple Yam using both Conventional and Ultrasound Extraction methods.

Analysis of Extracted Starch Properties: To investigate and compare the Physicochemical and phytochemical properties of the starch obtained from both Conventional and Ultrasound Extraction methods, including particle size, morphology, moisture content, and solubility.

Tablet Preparation and Optimization: To formulate tablets containing Metformin hydrochloride using starch extracted by both Conventional and Ultrasound Extraction methods as binding and disintegrating agents, optimizing tablet formulation parameters such as hardness, friability, and disintegration time.

Comparison of Starch Properties: To compare the functional properties of the starch, including its binding and disintegrating capabilities, in tablet formulations, assessing both the efficiency of the starch as a binder and its impact on the dissolution rate of the Metformin tablets.

Evaluation of Prepared Tablets: To evaluate the quality and performance of the prepared Metformin hydrochloride tablets, including physical characteristics (e.g., Weight variation, hardness, friability. Etc.) and *in-vitro* drug release profiles, using starch extracted through Conventional and Ultrasound Extraction methods.

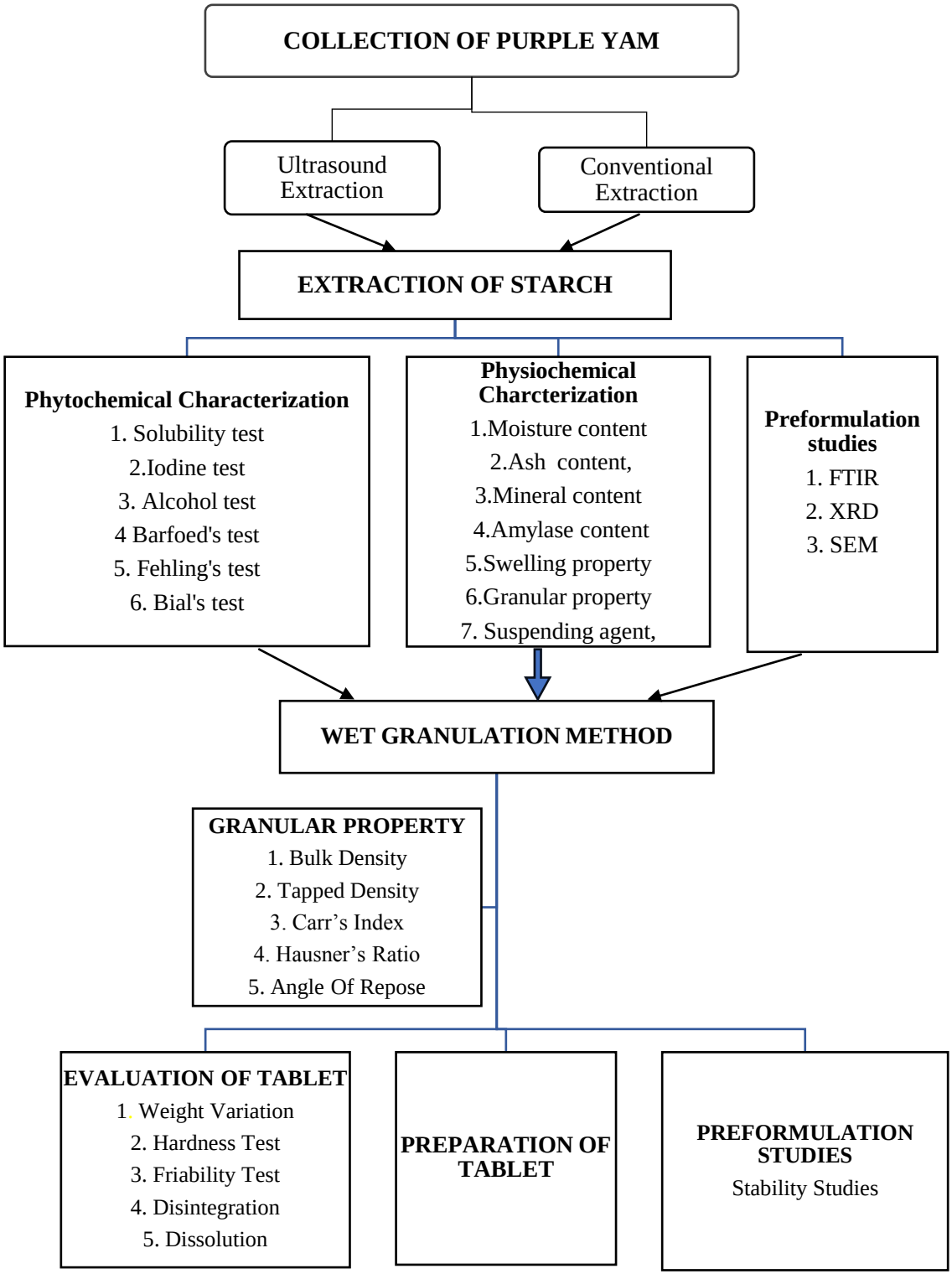
4. HYPOTHESIS:

Purple yam starch extracted by ultrasound methods will exhibit superior binding properties compared to starch obtained by conventional extraction. It is further hypothesized that tablets formulated with ultrasound-extracted starch will show improved mechanical strength, acceptable dissolution studies behaviours, and better stability during storage, making it a more effective tablet binding agent.

RESEARCH QUESTIONS:

1. How does ultrasound extraction compare with conventional extraction in terms of starch yield from purple yams?
2. What differences exist in the physiochemical properties of starch obtained by the two methods?
3. How does the extraction method affect the binding efficiency of purple yam starch in tablet formulations?
4. Are there significant differences in tablet mechanical properties (hardness, friability, disintegration) between tablets prepared with ultrasound and conventionally extracted starch?
5. How does the extraction method influence the dissolution behaviour of the formulated tablets?
6. Do tablets containing purple yam starch remain stable under accelerated and long-term storage conditions?
7. Is ultrasound-extracted purple yam starch a suitable alternative to conventional tablet binders?

5. PLAN OF WORK:



6. REVIEW LITERATURE:

6.1.PURPLE YAM

- **JS. Ochoa, J.F. Osorio-Tobón (2022),** found that the Isolation and characterization of starch from the purple yam (*Dioscorea alata*) anthocyanin extraction residue obtained by ultrasound-assisted extraction**.**

- **Carlos piler (2023)** found that purple yam starch was extracted by the ultrasonication technique, despite the change in increasing yield ultrasound caused changes on physical and chemical characteristics depending on time and amplitude hence it may be used as an alternative technique for physical starch modification

6.2.PHYTOCHEMICAL TEST

- **Brunnsch weiler, et.al.,** Isolation, Physicochemical Characterization and Application of Yam (Dioscorea's.) starch a thickening and gelling agent, Starch/Stärke57(2022)107–11.

- **Setyaningsih et al. (2021)** optimized ultrasound-assisted extraction of cassava starch, improving both starch yield and modifying its properties. the study showed that ultrasound-enhanced extraction resulted in better functional properties, including higher amylose content and improved texture. the research highlighted the potential of ultrasound to optimize starch extraction processes and improve the quality of cassava starch for food applications.

- **Luiza Helena Meller da silva (2023)** found that purple yam starch was extracted from the Dioscorea trifida by aqueous and alkaline ways. The extraction method induced changes in the properties of starches, these changes did not compromise the functionality of the extracted starch, and the purple yam starch was left unmodified. Starch can be used in preparations that require higher resistance to high temperatures as well as exposure to longer preparation times

- **Lebot et al. (2022**) reviewed the phytochemical content and potential uses of Dioscorea alata, a species of yam that is widely distributed globally. The study highlighted that Dioscorea alata is rich in bioactive compounds such as flavonoids, polyphenols, and diosgenin. These compounds exhibit antioxidant, antimicrobial, and anti-inflammatory.

6.3. EVALUATION OF TABLET

- **Joseph Anireju Lori (2022)** found that Yam starch showed better hardness while the corn starch gave a slightly better friability in the tablets Yam starch when extracted at pharmaceutical grade can therefore be considered an effective and viable alternative binder in the pharmaceutical formulation of tablets.

- **Bharath s et al (2024) found** that the binder capacity of polymer could be depicted in the order Gelatine> Acacia> Potato starch > Yam starch > corn starch.

7. MATERIAL AND METHODS

7.1. PLANT COLLECTION:

Tubers of *Dioscorea alata L.* were collected from the agriculture department in Trichy. Sodium hydroxide, Fehling's solution A and B, Barfoed's reagent, Bial's reagent, Iodine, and Ethanol were purchased from Rohini Chemicals, Chennai; all are laboratory-grade chemicals only.

Figure 1: Purple yam

7.2. METHODLOGY

ISOLATION OF STARCH FROM PURPLE YAM

• Conventional Method

• Ultrasound Method

7.3.CONVENTIONAL METHOD:

The Dioscorea alata tubers were washed, cut, and soaked in 0.05% sodium hydroxide for 24 hours. After rinsing to neutralize the pH, the tubers were blended with distilled water to form a slurry, filtered to extract the starch, which was then air-dried and weighed to determine the yield as a percentage of the initial tuber weight.

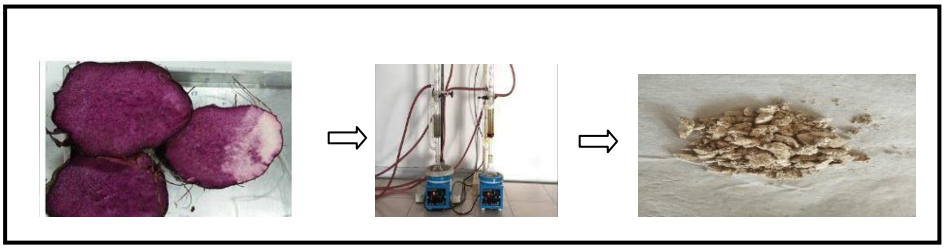


Figure2: Conventional Extraction

7.4. ULTRASOUND EXTRACTION:

Ultrasound extraction of purple yam starch utilized the ultrasonic probe UP 200st (200W, 20kHz) with 50g of purple yam for 10 minutes at room temperature. The study assessed three extraction variables: solvent-to-sample ratio (10:1, 20:1, 30:1), ultrasonic power (30% to 90%), and pulse duty cycle (0.3 to 0.9). Post-extraction, solid materials were filtered, and the extract stand overnight before being dried for 24 hours at 50°C. The yield of starch was calculated to evaluate the extraction method's effectiveness.

Figure 3: Ultrasound Extraction

7. PHYTOCHEMICAL ANALYSIS:

The study confirmed the presence of starch, mucilage, reducing sugars, and glucose in Dioscorea alata starch using standard phytochemical assays, including the iodine test for starch, Fehling's test for reducing sugars, alcohol test for mucilage, Barfoed's test for monosaccharides, and Bial's test for pentoses, following established protocol.

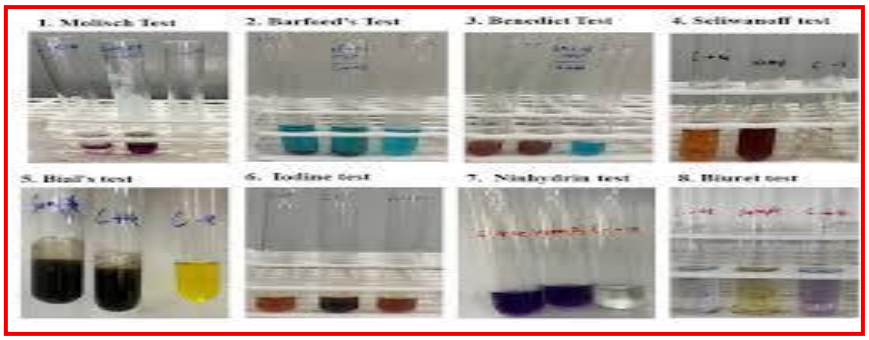


Figure4: Phytochemical test

7.1.SOLUBILITY TEST:

The solubility of the *Dioscorea alata* starch was tested using both cold and hot water. The

starch was observed for its ability to dissolve in these solvents, which provided insights into its physical properties and potential application.

7.2.PH TEST:

The pH of Dioscorea alata starch solution was measured to assess its acidity or alkalinity, impacting its behaviour in various chemical and biological environments.

7.3.MOLISCH'S TEST:

In this test, carbohydrates in a sample were confirmed by 2 ml of the test solution with Molisch's reagent and concentrated sulphuric acid, resulting in a purple or violet colour ring at the layer junction, indicating carbohydrate compounds.

7.4.ALCOHOL TEST:

To perform the alcohol test, a mixture of 2 ml starch solution and 1 ml ethanol was boiled, resulting in a slight precipitate that suggests the presence of mucilage or soluble components typical in starch-rich materials.

7.5. FEHLING'S TEST:

Fehling's test detects reducing sugars by heating a mixture of the test solution and Fehling's solutions A and B, producing a red precipitate that confirms the sugars' ability to reduce copper ions.

7.6. BARFOED'S TEST:

Barfoed's test involves mixing 2 ml of the test solution with 2 ml of Barfoed's reagent, followed by heating for two minutes. The appearance of a brick-red precipitate indicates the presence of monosaccharides, particularly reducing sugars, reacting with the reagent in acidic conditions.

7.7.IODINE TEST:

To perform the iodine test, 2 ml of the test solution was mixed with iodine solution. The appearance of a purple or black colour indicated the presence of starch, as iodine forms a coloured complex with starch molecules, confirming their presence in the sample.

7.8.Bial's Test:

In Bial's test, mixing 2 ml of the test solution with 1 ml of Bial's reagent and boiling it produces a greenish-blue colour if pentoses or related sugars are present, indicating a specific reaction between the reagent and these sugars.

8. PHYTOCHEMICAL CHARACTERIZATION:

8.1.ANALYSIS OF AMYLASE CONTENT:

Amylase enzyme activity was assessed using a 1% glucose solution as substrate. The protocol involved mixing 20 µl of glucose solution with 200 µl of 0.1M sodium acetate buffer (Ph 5.6) and 50 µl of crude enzyme extract, followed by incubation at 37^0 C for 30 minutes. Subsequently, 90 µl of dinitro salicylic acid (DSA) was added, and the mixture was boiled for 15minutes to develop colour.

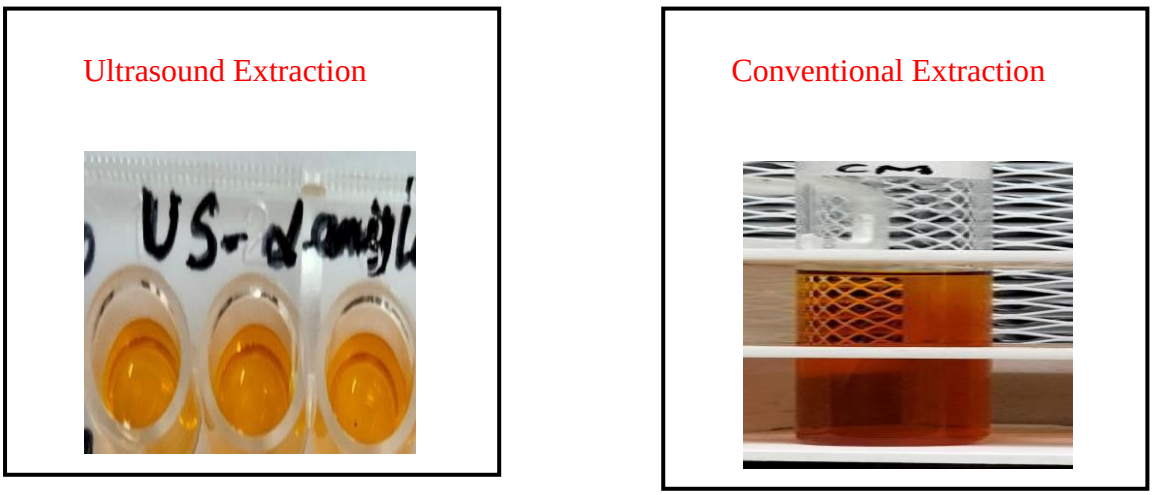


Figure5: Amylase Content

8.2. ANALYSIS OF α- AMYLASE INHIBITORY ACTIVITY ASSAY:

In this study, the α-amylase inhibitory activity of the eucalyptus extracted was evaluated using a method modified from Dong et al., 2012. Both extracted starch at varying concentration (500, 250, 100, 50, and 10 µg/ml) was incubated with α-amylase solution (1.0µg/ml, pH 6.9) at 25°Cfor 30 minutes. After this pre-incubation, starch solution was added to initiate the reaction at 37°Cfor 5 minutes followed by termination with DNS reagent and colour development in a boiling water bath. Absorbance at 540 nm was measured to assess enzyme activity, with control and blank incubations ensuring appropriate reference value.

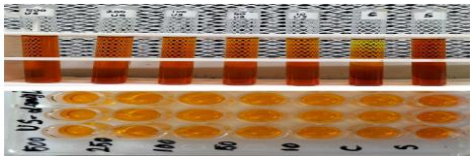
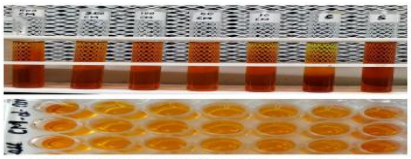
Ultrasound Starch	Conventional Starch
	

Figure 6: A- Amylase Inhibitory

8.3. ESTIMATION OF MOISTURE CONTENT:

The moisture content of purple yam starch extracted by ultrasound and conventional methods was measured oven-drying method. Samples weighing (2-3gm) were dried at 105^0C until constant weight then cooled in a desiccator and reweighed. Moisture content was calculated as the percentage of initial weight. All measurements were conducted in triplicate, and the mean values were used for comparison.

8.4. ESTIMATION OF ASH CONTENT:

The total ash content of the samples was evaluated using conventional and ultrasound extraction methods, involving incineration of 1.00 g samples at 550°C for four hours to remove organic matter. Samples were dried at 103 ± 2°C prior to incineration and cooled in a desiccator afterward to avoid moisture absorption, while the ultrasound method ensured the integrity of the samples for reliable results.

8.5.ESTIMATION OF MINERAL CONTENT FOR BOTH EXTRACTION METHODS:

8.5.1. NITROGEN:

The nitrogen content in the test sample was measured using a colorimetric method with the Doctor-N Capsule. A 5 ml sample was mixed with the capsule in a clean test tube and allowed to develop colour for 20 minutes, after which the colour was compared to a reference chart to ascertain the nitrogen concentration.

8.5.2. PHOSPHORUS

Phosphorus concentration was measured using a colorimetric method with the Doctor-P Capsule. A 5 ml sample was mixed with the capsule, TCA reagent was added, and the

mixture rested for 20 minutes. The resulting colour was compared to a reference chart to determine phosphorus levels.

8.5.3. MAGNESIUM HARDNESS:

Magnesium hardness is typically measured using complexometric titration with EDTA after removing or masking calcium, employing starch as an indicator. Ultrasound extraction enhances the interaction between magnesium ions and reagents, increasing the efficiency of extraction and reaction prior to titration.

Name of the Sample	Nitrogen	Phosphorus	Magnesium
ULTRASOUND METHOD			
CONVENTIONAL METHOD			

Figure7: Foamability test

8.6.ESTIMATION OF FOAMABILITY STUDIES:

We assessed the foamability of surfactant solutions using an automated Bartsch test, adjusting angles from 0º to 135º to enhance foam formation. The method involved agitating 10 ml of solution at 0.813 s-1 and measuring trapped air volume (VA) post-agitation at 20 °C, ensuring low surfactant concentrations for statistical accuracy.

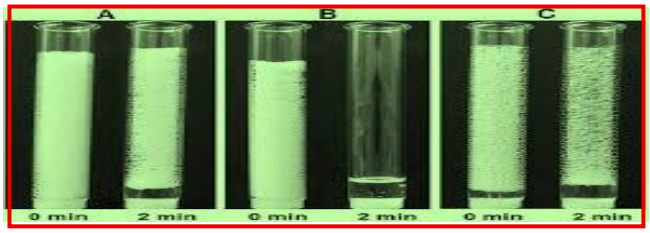


Figure 8: Foamability test

8.7. ESTIMATION OF SWELLING POWER:

The swelling power of starch is its capacity to absorb water and expand, essential for its role as a thickening agent and disintegrant in pharmaceuticals. This property is affected by the amylopectin content and crystalline structure, influencing water absorption prior to granule rupture. High swelling starches like potato and tapioca yield viscous pastes, whereas low swelling starches such as corn and rice create less viscous pastes.

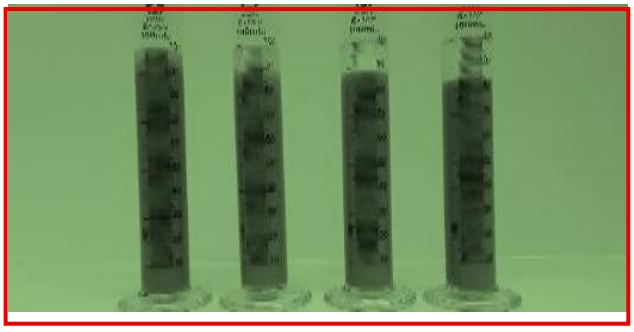


Figure 9: Swelling power

8.8.SUSPENDING AGENT:

A suspending agent increases suspension viscosity. Sedimentation volume is the ratio of ultimate sediment volume (Vu) to original sediment volume (Vo). To prepare the suspension, mix CaCO3 with 50ml water to create a paste, then add purple yam starch. Transfer to a 100ml cylinder, rinse the mortar with 10ml water multiple times, and add water to achieve a total volume of 100ml.

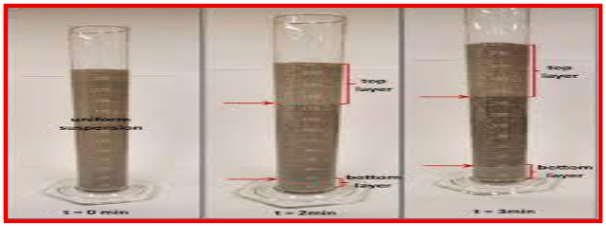


Figure10: Suspending agent

8.9.EMULSIFYING AGENT:

An emulsifying agent stabilizes mixtures of immiscible liquids, like oil and water, by forming barriers around droplets to prevent separation. Examples include natural agents like acacia gum and gelatine, as well as synthetic surfactants such as Polysorbate 20 and lecithin. The selection of an emulsifier and its application method depend on the desired emulsion type and the specific needs in food, pharmaceuticals, or industrial processes.

8.10. GRANULAR PROPERTY

Particles having size range between 50 and 1500um are estimated by sieving method. In this method, the size is expressed as d sieve, which describes the diameter of sphere that passes through the aperture as the asymmetric particle.

9. PREFORMULATION STUDIES

9.1.FOURIER TRANSFORM INFRARED SPECTROSCOPY:

An IR spectrometer (PerkinElmer, Spectrum 400) recorded the infrared spectrum by mixing one milligram of material with one hundred milligrams of potassium bromide (KBr) and compressing it into a transparent tablet. The operational range was from 400 to 4000 cm^{-1}.

9.2.SCANNING ELECTRON MICROSCOPY

Starch granule structure was analysed using scanning electron microscopy (SEM) after metallized gold coating for conductivity. Observations were made at 300X magnification and 16 kV accelerating voltage, with granule size measured via Scandium 5.1 software.

9.3. X RAY DIFFRACTION

X-ray diffraction (XRD) analysis of starch samples was performed with a Rigaku Mini Flex 300 diffractometer, ensuring consistent moisture using a saturated $bacl_2$ solution. Data processing utilized Origin software, with relative crystallinity calculated based on the

method by Nara and Komiya (1983), comparing crystalline peak areas to the total area. This quantitative analysis is essential for assessing the functional properties of starch.

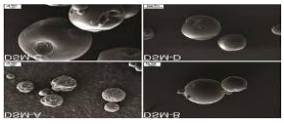
10. PREPARATION OF TABLET:

TABLE 1: Formulation of Metformin Hcl Tablet

S. No	INGREDIENTS	USES	Ultrasound Starch				Conventional Starch				Pvpk-30(Std Binder)			
			F I	F II	F III	F IV	F V	F VI	F VII	F VIII	F IX	F X	F XI	F XII
1	Model drug (Metformin hydrochloride)	Active ingredient	500	500	500	500	500	500	500	500	500	500	500	500
2	Lactose Monohydrate	Diluent	172.5	172.5	172.5	172.5	172.5	172.5	172.5	172.5	172.5	172.5	172.5	172.5
3	Microcrystalline cellulose	Filler	85	75	65	55	85	75	65	55	85	75	65	55
4	Conventional Starch	Binder	75	85	95	105	-	-	-	-	-	-	-	-
5	Ultrasound starch	Binder	-	-	-	-	75	85	95	105	-	-	-	-
6	PVP K 30	Standard binder	-	-	-	-	-	-	-	-	75	85	95	105
7	Carbo-sil	Glidant	5	5	5	5	5	5	5	5	5	5	5	5
8	Water	Filler	QS	QS	QS	QS	QS	QS	QS	QS	QS	QS	QS	QS
9	Magnesium stearate	Lubricant	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
	Total		850	850	850	850	850	850	850	850	850	850	850	850

11. FLOW PROPERTY OF GRANULES:

TABLE 2: Granular property of drug

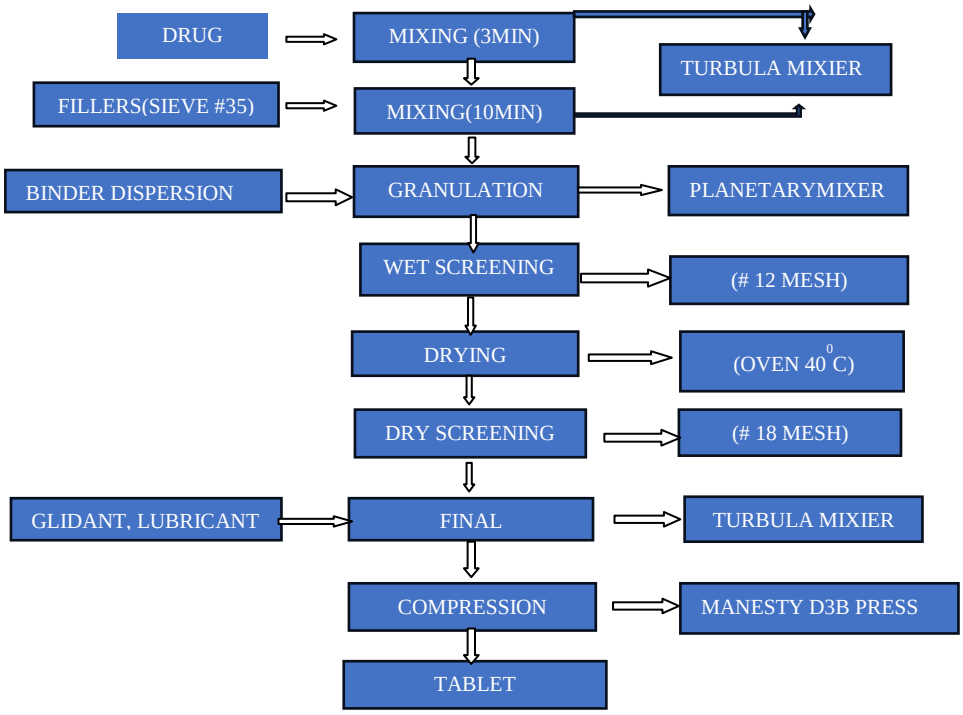
S.NO	FLOW PROERTY OF GRANULES	FORMULA	IMAGE
1.	**BULK DENSITY:** Bulk density is the mass of a material's particles relative to the total volume they occupy, encompassing particle volume, inter-particle void volume, and internal pore volume. It is not an intrinsic property of the material.	Bulk Density = Weight of powder (gm)/ Bulk volume (ml)	
2.	**TAPPED DENSITY:** Tapped density of the drug was determined by pouring 25 grams into a 100ml cylinder, tapping it from a height of 2 inches until a constant volume was achieved, and calculating the tapped density from the recorded volume.	Tapped Density = Weight of powder (gm.)/ tapped volume (ml)	
3.	**CARR'S INDEX:** Compressibility is the capacity of powder to decrease in volume under pressure, used to evaluate flow properties by comparing bulk and tapped densities.	Carr's index = Tapped density – Bulk density)/ Tapped density × 100	-
4.	**HAUSNER'S RATIO:** The Hausner's ratio (HR) measures the relationship between tapped density (Dt) and bulk density (Da), where tapped density reflects the powder mass per volume after tapping, and bulk density is based on mass per untapped volume.	Hausner's Ratio = Tapped density (Dt)/ Bulk density (Da)	-
5.	**ANGLE OF REPOSE:** The angle of repose is the maximum angle between the surface of a pile of powder or granules and the horizontal plane, serving to characterize the flow properties of solids.	$\tan^0 = h/r$ h–height of the powder heap r –radius of the powder heap ^{0} - angle of repose	
6.	**PARTICLE SIZE DISTRIBUTION:** In a mechanical shaker, a 100-gm blend is weighed, placed on a secured sieve, and shaken for 10 minutes, after which the retained weight on each sieve is measured to analysed for a normal distribution pattern.	$M = \frac{\pi \times D^3 \times \rho}{6}$	
7.	**POROSITY:** Porosity is defined as the ratio of the volume of voids or pore space to the total volume, with percent porosity calculated using a specific formula.	Percent porosity = V_b – V_t / V_b *100	
8.	**APPARENT DENSITY:** The density of a material is its mass divided by its total volume, incorporating both solid volume and internal pores or voids.	ρb = m / V	

12. TABLET COMPRESSION MACHINE:

The Manesty D3B Tablet Press is a rotary machine used in the pharmaceutical industry for compressing powdered ingredients into tablets. It features 16 stations designed for D-type tooling and can produce 30,000 to 60,000 tablets per hour. The machine allows for adjustments in weight, thickness, and hardness, making it ideal for medium-scale production with a focus on consistent and reliable output.

Figure 11: Tablet compression Machine

13. PREPARATION OF TABLET:



14. EVALUATION OF TABLET:

Evaluation is done to ensure the physical stability, chemical safety and efficacy of dosage form before it gets introduced into the market.

14.1. GENERAL APPEARANCE:

The article emphasizes the importance of a tablet's general appearance in gaining consumer acceptance. It highlights that several attributes must be measured, including the shape, size, colour, odour, taste, surface texture, physical flaws, and overall consistency of the tablet.

14.2. SIZE AND SHAPE:

The shape and size of tablet can be dimensionally described, monitored and controlled. Shape of the tablet can be round, rectangular, triangular, hexangular, octangular and rod shape and size of the tablets is guided by its weight.

Table 3: Evaluation of tablets used in equipment

S.NO	EVALUATION OF TABLET	IMAGE
1.	Weight Variation: Weigh 20 tablets individually in a batch to determine their average weight. Calculate the percentage deviation using the specified formula and compare it against the limits set by the monograph.	
2.	**Hardness test:** The hardness of a tablet which indicates its ability to withstand mechanical shocks, is measured using a Pfizer hardness tester expressed in kg/cm. To determine hardness, three randomly selected tablets each batch are tested, and their mean and standard deviation values are calculated.	
3.	**Friability Test:** This test was performed with ROCHE FRIABILATOR, evaluating tablet strength and breakage. The apparatus features a drum with a diameter of 280-290mm and a thickness of 30mm, rotating at 25rpm for 100 revolutions per tablet. For the batch to pass, friability must be less than 1%	
4.	**Disintegration:** It is the process by which a tablet breaks down into smaller particles, with the disintegration time measured using a specified apparatus that tests six tablets at 370 ± 20°C in 900 mL of distilled water, recording the total time for complete disintegration.	
5.	**DISSOLUTION TEST:** *In-vitro* dissolution study of metformin tablets utilized a phosphate buffer (pH 6.8) at of $37^0 \pm 2^0$ C in USP II dissolution test apparatus and at rotation speed of 50 rpm. Samples were collected at set time intervals (5, 1 0, 15, 20, 30, 45 and 60 min), filtered through Whatman filter paper and examined for absorbance at 236 nm using a UV spectrophotometer to calculate drug release percentage.	

15. STABILITY STUDIES:

Stability of a drug refers to the duration from manufacture to when its potency and physical characteristics remain acceptable. It is a critical factor in the design and evaluation of drug dosage forms for their acceptance or rejection.

ICH guidelines for stability study

In the present work stability study was carried out for the optimized formulation at 40ºC±2ºC/75%RH±5%RH for six months.

16. RESULT AND DISCUSSION

16.1 ULTRASOUND AND CONVENTIONAL EXTRACTION METHOD:

Purple yam starch yields vary by extraction method, with ultrasound extraction achieving yields between 41% and 71.3%, surpassing conventional techniques. Although the total starch content in purple yam is relatively low at about 16-20% of the biomass, ultrasound extraction significantly enhances yield potential, marking purple yam as a promising starch source.

Table 4: Yield value of both extraction methods

Ultrasound Extraction Method	Conventional Extraction Method
The yield value of Ultrasound extraction of purple yam starch is 71.3%	The yield value of Conventional extraction of purple yam starch is 43.27%

16.2 PHYTOCHEMICAL TEST:

The extensive demand for phytochemicals has resulted in the shifting of the extraction process from conventional extraction to more ultrasound extraction.

Table 5: Phytochemical test

S. No	Experiments	Conventional extraction method	Ultrasound extraction method	Inference
1.	**SOLUBILITY**	Soluble in hot water. Insoluble in cold water.	Soluble in hot water. Insoluble in cold water.	Similar with standard starch.
2	**PH**	5.6	7.6	Similar with standard starch
3.	**IODINE TEST**: 2gm of sample + 2ml of iodine solution.	Deep blue colour is formed.	Deep blue colour is formed.	Presence of starch.
4.	**ALCOHOL TEST:** 2gm of sample + 2ml of ethanol.	Slightly precipitate is produced.	Slightly precipitate is produced	Presence of amylose.
5.	**FEHLING'S SOLUTION:** 2 g of sample + 2ml of Fehling's A & B solution.	Red colour is formed.	Red colour is formed.	Presence of reducing sugar.
6.	**BARFOED'S TEST:** 2gm of sample + 2ml of Barford's reagent.	Brick red colour is formed.	Brick red colour is formed.	Presence of reducing sugar.
7.	**BIAL'S TEST:** 2gm of sample + 2ml of bial's reagent.	Greenish blue colour is formed.	Greenish blue colour is formed.	Presence of ribose and glucose.

16.3PHYSIOCHEMICAL TEST:

16.3.1 Analysis of Amylase content:

The calibration curve for amylase activity was performed. The Calibration curve yields a straight line with slope m 0.534 and 0.684, and the regression coefficients of 0.7251 and 0.9851Ultrasound extraction improved amylase content by about 60% over conventional methods, highlighting its effectiveness in enhancing extraction efficiency.

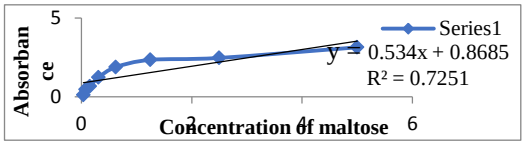
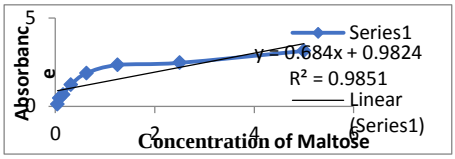
Ultrasound Extraction Method	Conventional Extraction Method
	

Figure 9: Amylase content

16.3.2. Analysis Of Alpha Amylase Inhibitory Assay:

The Ultrasound method showed higher α-Amylase activity compared to the conventional method. This increase can be attributed to improved enzyme- substrate interaction due to starch structural modification by the ultrasound method.

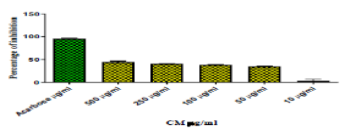
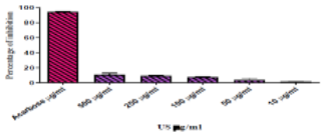
Ultrasound Extraction Method	Conventional Extraction Method
	

Figure 10: Alpha Amylase Inhibitory Assay

16.3.3. Moisture Content:

Ultrasound extraction of starch results in lower moisture content compared to conventional methods, attributed to the cavitation effect that enhances water removal and promotes efficient drying of starch granules. This ultrasound-extracted starch is characterized by free-flowing properties, stability, and resistance to microbial contamination.

Table 6: Moisture Content

Name Of the Sample	Before Drying	Heated At 50^0c	After Drying	Yield Value
Ultrasound Extraction				**5.1%**
Conventional Extraction				**7.4%**

16.3.4. Ash Content:

The ash content of starch from ultrasound extraction (0.06%) was significantly lower than that from conventional extraction (1.35%), indicating that ultrasound extraction enhances starch purity by effectively removing mineral impurities.

Table 7: Ash Content

S. No	Name of the Sample	Sample quantity (gm)	Total ash content (%)
1.	Ultrasound Extraction	1	0.06%
2.	Conventional Extraction	1	1.35%

16.3.5. MINERAL CONTENT:

The study found that starch extracted via ultrasound extraction had significantly lower mineral content compared to conventional extraction methods. The conventional method revealed higher residual mineral content, indicating incomplete removal of inorganic components. In contrast, ultrasound extraction enhanced mineral leaching and disrupted cell walls, leading to improved purification efficiency and confirming higher purity of ultrasound starch.

Table 8: Mineral Content

S. No	Name of the Sample	Magnesium	Nitrogen	Phosphorus
1.	Ultrasound Extraction	50	0.05	0.05
2.	Conventional Extraction	50	0.05	0.05

16.3.6. SWELLING PROPERTIES:

Water serves as a swelling agent for conventional and ultrasound starch, with ultrasound extraction significantly enhancing starch-water interactions, thereby improving swelling behaviour and functional properties. This study examines these swelling properties.

Table 9: Swelling Properties

Parameter	Ultrasound Extraction	Conventional Extraction
Swelling agent	40.5%	72.6%

16.3.7. SUSPENDING AGENT:

Ultrasound extraction modifies starch granule morphology and particle size, leading to increased surface area and improved hydration. These changes enhance the

ability of starch to increase the viscosity of the dispersion medium and maintain particles in suspension. Consequently, ultrasound-extracted starch demonstrated superior suspending properties compared to conventional starch was found.

Table 10: Suspending Agent

Parameter	Conventional with concentration (Time-60 min)		Ultrasound with concentration (Time-60 min)	
Sedimentation Rate	High	1% - 0.51	Low	1% - 0.74
Sediment Nature	Hard Cake	2% - 0.61	Loose, Flocculated	2% - 0.80
Dispersibility	Poor	3% - 0.72	Good	3% - 0.84
Viscosity	Lower	4% - 0.66	Higher	4% - 0.85
Suspending Efficiency	Low	5% - 0.68	High	5% - 0.74

16.3.8. EMULSIFYING AGENT:

Ultrasound extraction resulted samples with significantly enhanced higher emulsifying activity and stability compared to conventional methods, demonstrating superior emulsifying potential.

Table 11: Emulsifying Agent

Extraction method	Emulsifying activity index (m^2/g)	Emulsifying stability index (min)
Ultrasound Extraction	38.9 ± 1.6	92.7 ±3.5
Conventional Extraction	24.6 ± 1.2	61.4± 2.8

16.3.9. FOAMING AGENT:

Ultrasound extraction alters the surface characteristics of starch granules via cavitation, resulting in increased surface area and interfacial activity. This enhances air bubble entrapment and stabilization, thereby improving foaming properties relative to conventional starch.

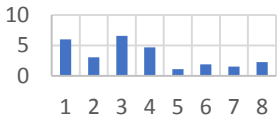
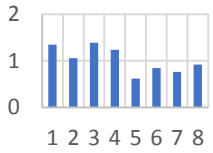
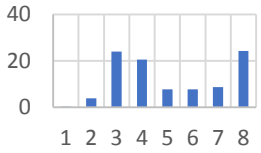
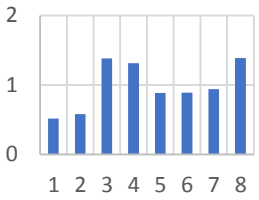
TABLE 12: Foaming Agent

Parameter	Ultrasound starch	Conventional starch
Foaming capacity	49.8%	32.5%
Foam stability	78.9%	55.6%
Bubble structure	Fine, uniform	Large, unstable
Air entrapment	Enhanced	Limited
Foaming efficiency	High	Low

16.3.10. PARTICLE SIZE DISTRIBUTION:

Ultrasound extraction significantly altered starch particle size distribution by inducing acoustic cavitation, leading to mechanical shear forces that break starch granules and disrupt inter-particle bonding. Consequently, ultrasound-extracted starch displayed a reduced and more homogeneous particle size distribution compared to conventionally extracted starch.

Table 13: Particle Size Distribution

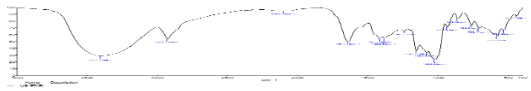
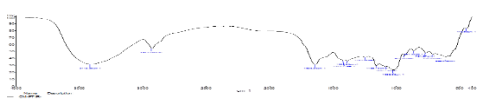
ULTRASOUND EXTRACTION		CONVENTIONAL EXTRACTION	
Arithmetic method (aperture size)	**Logarithmic method (Weight)obtained**	**Arithmetic method (aperture size)**	**Logarithmic method (Weight)obtained**
			

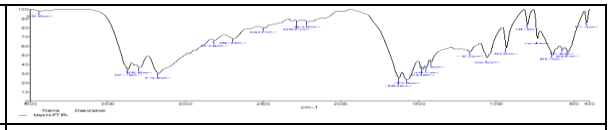
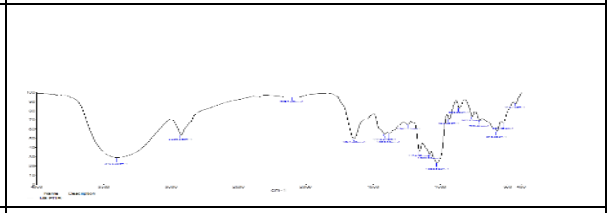
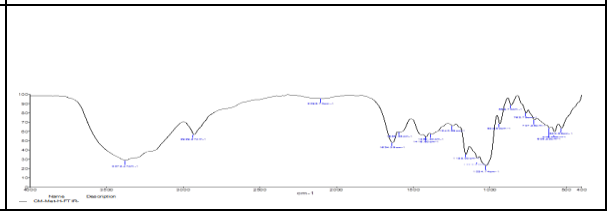
17. PREFORMULATION STUDIES

17.1. FTIR:

Ultrasound extraction altered the molecular organization of starch, impacting hydrogen bonding and reducing crystallinity. This led to increased hydrogen bonding between ultrasound-modified starch and metformin HCl, suggesting enhanced drug-polymer interactions that could improve drug encapsulation and modify release behaviour. FTIR analysis verified the compatibility of metformin HCl with both conventional and ultrasound extraction methods**.**

Table 14: Analysis of FTIRS

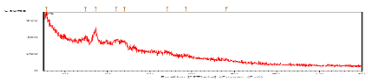
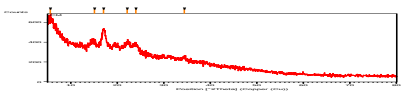
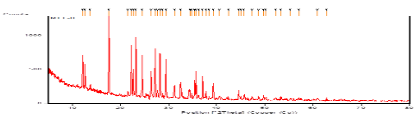
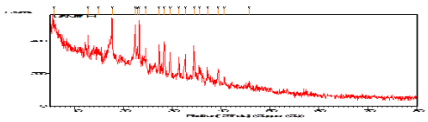
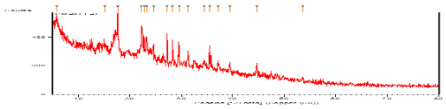
Name of the Extraction	**Analysis of FTIR**
Ultrasound extraction	
Conventional extraction	
Metformin Hcl	

	
Ultrasound extraction with Metformin Hcl	
Conventional extraction with Metformin Hcl	

17.2. .XRD:

Ultrasound treatment improves starch amorphization through mechanical shear and cavitation, reducing crystalline peaks of Metformin HCl, which enhances drug encapsulation and molecular dispersion. This process facilitates improved dissolution and controlled drug release. X-ray analysis confirms compatibility of Metformin HCl with both conventional and ultrasound extraction methods.

Table 15: Analysis of XRD

Name of the Extraction	Analysis of XRD
Ultrasound extraction	
Conventional extraction	
Metformin Hcl	
Ultrasound extraction with Metformin Hcl	
Conventional extraction with Metformin Hcl	

17.3. SCANNING ELECTRON MICROSCOPE

Ultrasound-extraction starch demonstrated a porous and irregular surface, enhancing Metformin HCl loading compared to conventional starch with smooth granules. SEM analysis confirmed Metformin HCl compatibility with both extraction methods.

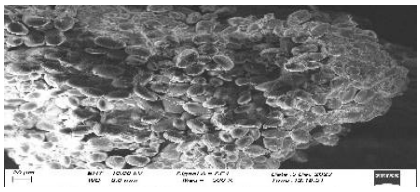
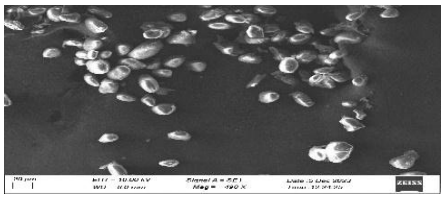
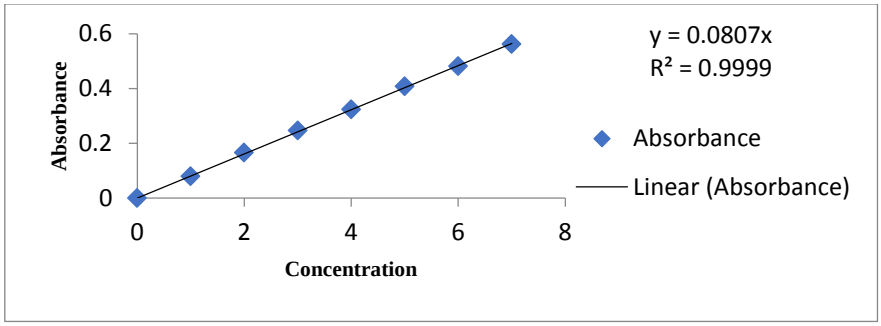
Conventional extraction	Ultrasound extraction
	

Figure 11: Sem

18. CALIBRATION CURVEFOR METFORMIN HYDROCHLORIDE:

A straight line indicates linearity, with a high coefficient ($r^2 > 0.999$). This curve serves as a standard for determining unknown Metformin HCL concentrations in samples like dissolution media. Absorption maxima were determined, and a calibration curve was developed by using different concentrations.



19. FLOW OF GRNULAR PROPERTY:

For all the formulations, the lubricated blend was evaluated for bulk density, tapped density, compressibility index, Hausner's ratio, and angle of repose, and their values are presented in the table. Granular properties of the ultrasound extracted sample showed the powder blend indicated good flow properties in the purple yam starch. The conventional extracted sample showed the powder blend indicated fair flow properties in this method.

Table 16: Flow Property of Granules

S. No	Evaluation Parameters	Ultrasound Starch				Conventional Starch				Pvpk-30(Std Binder)			
		FI	FII	FIII	FIV	FV	FVI	FVII	FVIII	FIX	FX	FXI	FXII
1.	Bulk density	0.44±0.016	0.43±0.001	0.46±0.014	0.41±0.013	0.712±0.025	0.792±0.014	0.781±0.03	0.8±0.014	0.441±0.01	0.432±0.01	0.42±0.014	0.453±0.013
2.	Tapped density	0.568±0.01	0.54±0.01	5.585±0.02	0.495±0.01	0.895±0.02	0.901±0.03	0.903±0.01	0.651±0.01	0.695±0.02	0.515±0.03	0.535±0.01	0.625±0.01
3.	Porosity	68.5±1	65.2±1	72.3±1	62.5±1	73.2±1	75.2±1	78.2±1	69.2±1	73.5±1	76.3±1	63.5±1	66.2±1
4.	Particle size distribution	0.58±0.01	0.554±0.07	0.585±0.01	0.495±0.01	0.895±0.01	0.901±0.03	0.903±0.02	0.651±0.01	0.695±0.06	0.515±0.04	0.535±0.05	0.625±0.01
5.	Apparent density	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01	120±0.01
6.	Hausner's Ratio	1.08±0.01	1.06±0.02	1.11±0.03	1.07±0.01	1.1±0.02	1.18±0.01	1.2±0.02	1.15±0.03	1.01±0.01	1.12±0.01	1.1±0.01	1.15±0.01
7.	Carr Index	8.13±1	9.13±1	9.16±1	9.28±2	11.4±2	11.49±1	12.69±2	13.19±1	11.19±1	10.53±1	10.19±2	9.65±1
8.	Angle of Repose	25.78±1	25.16±2	26.28±1	26.06±1	28.14±1	31.28±1	32.08±1	33.12±1	25.03±1	27.78±2	25.32±1	27.14±1

20. EVALUATION OF TABLETS:

Ultrasound treatment alters starch structure by reducing particle size and crystallinity while increasing porosity and swelling capacity. These changes improve tablet hardness, disintegration, and drug release, making ultrasound-treated starch a more efficient excipient than conventional starch in Metformin HCl tablet formulations. The present study of the evaluation of tablet confirmed the compatibility of Metformin Hcl with both conventional and ultrasound extraction methods.

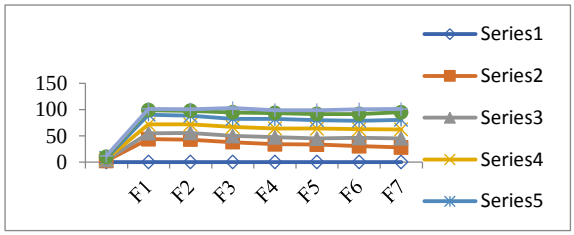
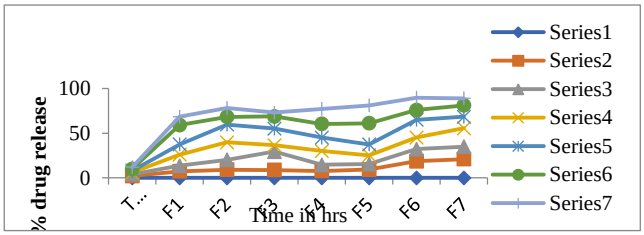
Table 17: Evaluation of Tablets

S. No	Evaluation of tablets	Ultrasound Starch				Conventional Starch				Pvpk-30(Std Binder)			
		FI	FII	FIII	FIV	FV	FVI	FVII	FVIII	FIX	FX	FXI	FXII
1.	Weight variation(mg)	850.32 ±2.37	850.35 ±2.47	849.79 ±2.32	850.80 ±2.54	848.42 ±3.47	850.19 ±4.32	849.07 ±1.69	851.98 ±3.03	850.19 ±4.32	849.07 ±1.69	850.36 ±4.52	850.32 ±233
2.	Thickness	5.982 ±0.17	6.59 ±0.37	6.105 ±0.72	6.03 ±0.78	6.00 ±0.59	6.105 ±0.72	6.18 ±0.23	6.65 ± 0.23	6.59 ±0.37	6.18 ±0.23	7.95 ±0.12	6.55 ±0.35
3.	Hardness	6.8 ± 1.2	6.5 ±3.5	73 ±2.5	6.9± 1.6	7.6±1.5	7.2 ±2.3	7.1± 2.5	6.9 ±2.5	7.5±1.6	7.3±5.1	6.7±1.2	6.2± 1.7
4.	Friability	0.58 ± 0.01	0.554 ± 0.07	0.585 ±0.01	0.49± 0.01	0.895 ±0.01	0.901 ±0.03	0.903 ±0.02	0.651 ± 0.01	0.695 ± 0.06	0.515 ± 0.04	0.535 ± 0.05	0.61± 0.01
5.	Disintegration	5.98 ±0.03	6.2 ±0.02	7.2 ±0.36	7.95 ±0.12	8.58 ±0.23	9.28 ±0.72	10.40 ±0.23	11.20 ±0.35	12.08 ±±	9.20 ±0.72	11.60 ±4.52	12.70 ±0.35
6.	Drug content uniformity	98.78±0.1	99.36±±0.35	98.11 ±0.02	98.57 ±0.03	99.10 ±0.12	98.9± 0.08	99.2± 0.05	98.4± 0.08	99.9±0.01	98.72 ±0.05	97.10 ±0.03	98.95 ±0.02

21. DISSOLUTION TEST:

The study shows that ultrasound starch tablets enhance Metformin HCl dissolution due to cavitation effects, leading to reduced starch particle size, increased surface roughness, and some amorphization. These modifications facilitate quicker medium penetration, faster tablet disintegration, and better drug diffusion than traditional starch. The findings confirm that Metformin HCl is compatible with both conventional and ultrasound extraction methods.

Table 18: Dissolution Studies

Cumulative drug release for Ultrasound starch	Cumulative drug release for Conventional starch
	

22. STABILITY STUDIES:

In the present work stability study was carried out for the optimized formulation at 40ºC±2ºC/75%RH±5%RH for six months. Purple yam starch from Dioscorea alata extracted via ultrasound is a promising natural tablet binder with improved stability and mechanical properties compared to conventionally extracted starch.

Table 19: Stability Studies

S. No	Evaluation of tablets	F IV -Ultrasound Starch				F VIII -Conventional Starch				F XII -Pvpk-30(Std Binder)			
		Initial	1-Month	3-Month	6-Month	Initial	1-Month	3-Month	6-Month	Initial	1-Month	3-Month	6-Month
1.	Weight variation(mg)	850.80 ±2.4	850.80 ± 2.4	850.80 ± 2.4	850.80± 2.4	851.98 ±3.03	851.98 ± 3.03	851.98± 3.03	851.98± 3.03	850.32 ± 2.33	850.32 ±2.33	850.32 ±2.33	850.32 ±2.33
2.	Thickness	6.03± 0.78	6.03 ±0.78	6.03± 0.78	6.03 ± 0.78	6.65 ±0.23	6.65 ±0.23	6.65 ±0.23	6.65 ±0.23	6.55 ±0.35	6.55± 0.35	6.55± 0.35	6.55± 0.35
3.	Hardness	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.2	6.2	6.2	6.2
4.	Friability	0.495± 0.01	0.495± 0.01	0.495± 0.01	0.495± 0.01	0.651± 0.01	0.651 ± 0.01	0.651 ± 0.01	0.651 ± 0.01	0.625± 0.01	0.625± 0.01	0.625± 0.01	0.625± 0.01
5.	Disintegration	7.95 ±0.12	7.95 ±0.12	7.95 ±0.12	7.95 ±0.12	11.2 ±0.35	11.2 ± 0.35	11.2 ± 0.35	11.2 ± 0.35	12.7 ± 0.35	12.7 ±0SSS.35	12.7 ±0.35	12.7 ±0.35
6.	Drug content uniformity	98.57	98.57	98.57	98.57	98.45	98.45	98.45	98.45	98.95	98.95	98.95	98.95
7.	Assay	99.124	99.124	99.119	99.119	78.225	78.204	78.079	78.079	89.831	89.802	89.556	89.556
8.	% Of Cumulative Drug Release	99.124	99.118	99.114	99.104	78.225	78.201	78.021	78.004	89.831	89.802	89.426	89.252

23. SUMMARY AND CONCLUSION:

This study evaluates purple yam (Dioscorea alata) starch as a natural tablet binder, comparing starch extracted using ultrasound and conventional methods. Results show that ultrasound extraction yields higher starch quantities, reduces extraction time, and improves functional properties. Tablets made with ultrasound-extracted starch showed good flow properties, mechanical strength, and acceptable disintegration and dissolution profiles. Stability studies reveal that formulations with ultrasound extracted starch retain better physical and chemical stability compared to conventional methods.

Ultrasound-extracted starch exhibits enhanced properties compared to conventional starch, including superior swelling, foaming capacity, and foam stability. XRD analysis indicates a B-type crystalline structure with increased crystallinity in ultrasound-extracted starch due to higher amylopectin content. SEM results show good particle sizes for both extraction methods. When formulating Metformin HCl tablets, formulations using ultrasound starch demonstrated a significantly higher dissolution rate and drug release than those with conventional starch. Additionally, purple yam starch emerges as a sustainable alternative to conventional binders, and ultrasound extraction offers efficiency and improved performance, warranting further industrial application studies on scale-up, stability, and compatibility with active pharmaceutical ingredients.

Overall, the findings suggest that purple yam starch, especially when extracted using ultrasound, can serve as an effective, economical, and eco-friendly alternative to conventional synthetic binders in pharmaceutical tablet formulations.

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ANNEXURE

1. Examination certificate and course completion certificate

SRI BALAJI VIDYAPEETH
Examinations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
Dr. **S. SRIRANGARAJ**
Controller of Examinations

Date: 21-06-2023

No. SBV/COE/Ph.D/A5

UNIVERSITY MEMORANDUM

Sub : Sri Balaji Vidyapeeth – Ph.D Degree in Part – I Course Work Assessment – Results Notified.

* * * * *

Mr/Mrs/Dr. **VAISHNAVI V,** UIN. **2005002018** Research Scholar in Pharmacy (Part Time - External) is declared to have passed the Ph.D Part-I – Course Work Assessment and he/she is permitted to continue the research under the guidance of Dr. **VIJAYAN V** and submit the thesis for the award of Ph.D Degree as per the regulations of SBV.

Sl. No.	Subjects	Result Status
1	PAPER - I RESEARCH METHODOLOGY AND BIOSTATISTICS	**PASS**
2	PAPER - II ON CHOSEN FIELD OF RESEARCH	**PASS**

SRI BALAJI VIDYAPEETH * CONTROLLER OF EXAMINATIONS * PONDICHERRY

S. Sriranjaraj
CONTROLLER OF EXAMINATIONS

To : Mr/Mrs/Dr. **VAISHNAVI V**

CC : Dr. **VIJAYAN V**, Assoc. Prof. of Pharmaceutical Sciences, School of Pharmacy.

1. RESEARCH AND PUBLICATION ETHICS

SRI BALAJI VIDYAPEETH

ACCREDITED BY NAAC WITH 'A++' GRADE
LISTED U/S 12B OF THE UGC ACT, 1956

DEEMED TO BE UNIVERSITY
DECLARED U/S 3 OF THE UGC ACT, 1956

CREDIT POINT 4

CERTIFICATE

This is to Certify that Dr./Mr./Ms..... Vaishnavi V .....

UIN No..... 2005002018 .....*Department of* ..... School of Pharmacy .....

has attended, actively participated and fulfilled the requirements as per University norms of the online workshop on ***"RESEARCH METHODOLOGY, BIO-STATISTICS AND PREPARATION OF SCIENTIFIC MANUSCRIPT"*** *conducted by Sri Balaji Vidyapeeth, Puducherry from 18.05.2022 to 24.06.2022*

Dr.G.Ezhumalai
Course Coordinator

Dr. S.R. Rao
Vice President (R,I & D)

Dr.Subash Chandra Parija
Vice Chancellor

SWAYAM ONLINE COURSE CERTIFICATION

This Certificate is awarded to

V.VAISHNAVI

for successfully completing the 2 credit course

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with a consolidated score of 80% marks

in the proctored examination held on 26-02-2023

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Indian Council of Medical Research
New Delhi, India

Dr. Madhur Gupta
Technical Officer- Pharmaceuticals
WHO Country office for India
New Delhi, India

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2. LIST OF PUBLICATIONS:

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Analysing Indian Yam (Dioscorea) Varieties Based on Starch Viscosity: A Comparative Scientific Study

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Abstract

Background: *yam (dioscoreae) stands as a crucial crop, rich in fiber and starch, widely utilized in food and pharmaceutical industries. This research delved into three indian yam cultivars: potato, elephant yam, and cassava.*

Aim: *the aim of the present study is to isolate the starches from potato, elephant yam, and cassava and their viscosity properties.*

Objective: *to isolate starches from potato, elephant and cassava starch by using alkaline extraction. To evaluate the viscosity properties of the isolated starches using brookfield viscometer.*

Methods and methodology: *The three different yams cultivars viz., potato, cassava and elephant yam were processed in the present investigation for isolation of starch and % yield of obtained starch was compared. The viscosity of the yam starches of three different varieties was studied by the brookfield viscometer. The viscosity, determined by using standard type of viscometer at 100 rpm, of the starch samples of the different varieties. Potato starch exhibited the highest viscosity, trailed by cassava and elephant yam. A comparative analysis of viscosity, depicted in the plot of % starch solution versus viscosity highlighted slight differences among varieties.*

Results: *Starch isolation via alkali extraction method was followed by characterization for viscosity using a brookfield viscometer. Starch yield ranged from 81% to 90% on a fresh weight basis. Potato exhibited the highest starch yield at 90%, while elephant yam showed the lowest at 81%, and cassava stood at 85%. For viscosity analysis, gruels were prepared from 1%, 2%, 3%, and 4% starch solutions in distilled water. After boiling and cooling, viscosity was measured using a standard viscometer at 100 rpm, expressed in centipoise. Results indicated a clear influence of processing pre-treatment on starch properties. Viscosity varied among cultivars and was concentration-dependent. Potato starch solution demonstrated the highest viscosity at 21.6 centipoise, followed by cassava at 18.5 centipoise, and elephant yam at 16.5 centipoise, all measured at 4% concentration.*

Conclusion: *These findings underscore the distinct rheological characteristics of starch from different yam cultivars and highlight the potential for tailored applications in various industries.*

Keywords: *yam starch; alkali extraction; viscosity; centipoise; brook-field viscometer.*

INTRODUCTION

Yam (Dioscorea), a vital tropical tuber crop, thrives across Africa, Asia, and South America, bolstering food security for millions in tropical and subtropical regions. Renowned for its rich carbohydrate and fiber content, yam serves as a cornerstone in the diets of many. Moreover, it holds cultural significance, with its products often employed as traditional remedies, such as addressing impotence in certain Japanese island communities. In India, a plethora of rice varieties enrich the culinary landscape, including Potato, Cassava, Elephant yam, Water

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Comparing The Purple Yam Starch Extraction By Ultrasound And Conventional Method

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Abstract

A polymeric carbohydrate known as starch or amylum is made up of many glucose units connected by Alpha-D-glycosidic linkages. Most green plants synthesis this polysaccharide as a means of storing energy. Starch is most frequently used as a binder and disintegrate in the creation of tablets and other solid dosage forms in pharmaceutical excipients. Typically, tubers contain a lot of starch. Kamara, potatoes (storage root), yam, taro, Jerusalem artichoke, and ulluco are a few examples.Purple yam is a starchy vegetable belonging to the "Dioscoreaceae" family and is known as greater yam. It is scientifically known as "Dioscoreaalata".Purple yam is a starchy root vegetable that is a great source of carbohydrates. However, there is no comparative extraction method for the extraction of starch from purple yam. So that current research aimed to extract the starch from purple yam using ultrasound and conventional method and comparing the purple yam starch production. Ultrasound extraction was performed using the ultrasonic probe UP 200ST, 200W, 20KHZ. Conventional method was performed in a beaker using distilled water. The slurry filtered by muslin cloth and the sediment of starch was collected and air dried. The dried powders of starch were weighed and the yield (%w/w) was calculated. The Ultrasound extraction method (71.3%) produced higher yield than conventional method (51.2%). This study confirms that, Ultrasound extraction method is optimal method than conventional method for extraction of starch from purple yam.

Keywords: *Dioscorea alata, starch extraction methods, Ultrasound extraction, polymeric carbohydrate.*

INTRODUCTION:

A polymeric carbohydrate known as starch or amylum is made up of many glucose units connected by Alpha-D-glycosidic linkages. Purple yam is a starchy vegetable belonging to the" Dioscoreaceae" family and is known as greater yam. It is scientifically known as " Dioscoreaalata". This tuber is often confused with sweet potatoes. Humans are familiar with about 600 species of yam. Purple yam has greyish brown skin and purple flesh that resemblesa sweet potato. Purple yam was first cultivated in new guinea and was later propagated throughout islands in southeast Asia. In India, the tribal regions of Karnataka, Maharashtra, odhisa and Kerala grow purple yam and several other varieties of roots and tubers. Starch is available abundantly in India.Purple yam having abundant quality of starch so we can use the starch as alternative binding agent to potato, wheat, maize starch. Purple yam is a starchy root vegetable that is a great source of carbohydrate, potassium, and vitamin C. They are rich in

Antioxidants including anthocyanin. The flavonoids in purple yams have been shown help lower blood sugar in those with type 2 diabetes. Purple yam may help improve your gut health. They have a wide range of culinary uses. Ultrasound extraction uses ultrasound energy and solvents to extract target compounds from various plants matrices. Ultrasound are the mechanical waves having frequency (>20KHZ) higher than audible frequency range of human hearing (20HZ to 20KHZ). The conventional extraction methods

3. PAPER & POSTER PRESENTATION:

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CERTIFICATE

This is to certify that Ms. Vaishnavi. Shanmuganath Associate Professor, from Department Of Pharmaceutics,Mayor Radhakrishnan College Of Pharmacy, Cuddalore, has presented a paper titled Exploring the Purple Yam Starch Extraction by Ultrasound and Conventional Method in the RUSA 2.0 Sponsored Two Days National Conference on Recent Advances in Pharmaceutical Technology and Innovative Breakthrough Therapies – 2023 organized by the Department of Pharmacy, Faculty of Engineering & Technology, Annamalai University, Annamalai Nagar - 608002 during 03rd & 04th of March 2023.

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